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AGRICULTURAL MEMORANDUM NO. 638

Dates of Return to Field Capacity in the North of Scotland

by W G Harper

Frequent enquiries are made for meteorological information relating to the return of the soil to field capacity, which is often the main limitation in autumn farming operations. Estimates of excess winter rainfall and excess spring rainfall for 17 stations in the North Scotland were given in Agricultural Memorandum No. 635, covering the 20 years 1954 to 1973, and the dates of return to field capacity derived from those calculations are examined in this paper. A few stations with shorter periods of record or non-standard periods were included in order to improve the coverage.

2. The model adopted for extraction of soil moisture was described in Agricultural Memorandum No. 635[1], and was that used in MAFF Technical Bulletin No. 24 for England and Wales[2], in which the validity of estimates is discussed in some detail.

3. In Table 1 are given the mean dates of return to field capacity for the 17 stations. They are given in ranking order of mean date of return, and these show quite a high correlation (0.90) with annual rainfall (R). Annual rainfall averages for the period 1916-50 were chosen for this comparison because they are widely available for the whole of Scotland as published rainfall maps. The overall range of mean dates of return is from 7 November at Kinloss and Nairn in the coastal region of the Moray Firth (R 615-635 mm) to 1 August at Dalwhinnie (R 1250 mm). Quartile values are included in the table, e.g. at Kinloss 25 per cent of the dates of return were in or before late September i.e. 5 years in 20, and 25 per cent were in or after early December.

4. Table 2 gives the extreme dates of return to field capacity at each station. At the one extreme, at Dalwhinnie in 3 years in 20, at Fettercairn in 2 years in 20, and at Glenlivet in 1 year in 14, rainfall exceeded potential evapotranspiration in every month and no soil moisture deficit developed. For the purpose of deriving a mean value the date of return for these years was taken to be 1 April. At the other extreme a deficit of soil moisture persisted throughout the entire winter of 1972/73 at Kinloss, Nairn and Fortrose. These were given nominal dates of return of 31 March (of the following year). It will be noticed that at all 12 stations for which the standard 20-year period of record was available the latest date of return was in 1972/73.

5. In Table 3 the computed dates of return are given for each year for the 12 stations with complete records for 1954-73.

6. Estimation of dates of return to field capacity

Estimates of mean date of return to field capacity and of upper and lower quartiles can be obtained from Fig 1 for any station given its annual average rainfall. Approximate extreme dates of return are also given. Alternatively values may be calculated from the following regression equations

				Correlation with R
Mean date of return	M	=	305 - 0.154 R	-0.90
Upper quartile	B	=	240 - 0.112 R	-0.79
Lower quartile	A	=	320 - 0.131 R	-0.94

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where R is in millimetres and M, B and A are given as day numbers with 1 April = 1, 1 May = 31, 1 June = 61, etc. For simplicity each month has been assumed to have 30 days.

7. Comments or suggestions concerning this paper would be welcomed by the author.

References

1. "Excess Winter Rainfall in the North of Scotland", W G Harper, Agricultural Memorandum No. 635, 1974.

2. "The Significance of Winter Rainfall over Farmland in England and Wales", Technical Bulletin No. 24, Ministry of Agriculture, Fisheries and Food, 1971.

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Table 1. Dates of Return to Field Capacity - Means and Quartiles

County	Station (1)	Mean	Quartiles		R mm (2)	Period (3)	Grid ref	Ht. m
(a) 20-years data 1954-73								
Moray	Kinloss	Nov 7	Late Sep	Early Dec	615		NJ 0763	5
Nairn	Nairn	Nov 7	Early Oct	Early Dec	635		NH 8757	6
Inverness	Inverness	Nov 1	Late Sep	Early Dec	660		NH 6746	4
Ross & Cromarty	Fortrose	Oct 25	Mid Sep	Late Nov	645		NH 7556	5
Banff	Banff	Oct 16	Late Aug	Mid Nov	745		NJ 6965	24
Banff	Fochabers	Oct 2	Late Aug	Late Oct	750		NJ 3560	32
Caithness	Wick	Oct 1	Early Sep	Late Oct	760		ND 3652	36
Aberdeen	Craibstone	Sep 28	Mid Aug	Early Nov	860		NJ 8711	91
Aberdeen	Braemar	Sep 20	Mid Aug	Late Oct	925		NO 1591	339
Orkney	Kirkwall	Sep 19	Early Sep	Mid Oct	1000		HY 4808	26
Sutherland	Strathy	Aug 26	Mid Aug	Late Sep	1090		NC 8361	38
Kincardine	Fettercairn	Aug 21	Late Jul	Mid Oct	990		NO 6778	171
(b) Stations with limited data or non-standard period								
Aberdeen	Rattray Head	Oct 11	Mid Sep	Early Nov	720	50-67	NK 0958	26
Kincardine	Stonehaven	Sep 27	Late Aug	Late Oct	770	41-60	NO 8786	4
Aberdeen	Fyvie	Sep 8	Mid Aug	Mid Oct	880	58-71	NJ 7639	66
Banff	Glenlivet	Aug 6	Early Jul	Mid Oct	925	47-60	NJ 1930	331
Inverness	Dalwhinnie	Aug 1	Late Jul	Early Sep	1250	39-58	NN 6485	358

Notes: (1) Stations listed in order of mean date of return to field capacity.
(2) Rainfall average 1916-50.
(3) Period of records used, if differing from 1954-73.

Table 2. Extreme Dates of Return to Field Capacity

Earliest Return			R mm(3)	Latest Return			R mm(3)
(a) 20-years data 1954-73							
Late Aug	1956, 1957	Nairn	635	Did not return	1972/3	Kinloss	615
Mid Aug	1956	Inverness	660	" " "	1972/3	Nairn	635
" "	1956	Fortrose	645	" " "	1972/3	Fortrose	645
Early Aug	1957	Kinloss	615	Late Feb	1973	Banff	745
" "	1957	Kirkwall	1000	Mid Feb	1973	Inverness	660
" "	1958	Banff	745	Mid Jan	1973	Fochabers	750
" "	1966	Wick	760	" "	1973	Craibstone	860
Mid Jul	1958	Fochabers	750	Early Dec	1972	Braemar	925
" "	1957	Craibstone	860	Late Nov	1972	Wick	760
Late May	1954	Strathy	1090	Mid Nov	1972	Fettercairn	990
" "	1958	Braemar	925	Early Nov	1972	Kirkwall	1000
No deficit	1958, 1965	Fettercairn	990	" "	1972	Strathy	1090
(b) Stations with limited data or non-standard period(2)							
Mid Aug	1957	Rattray Head	720	Early Dec	1947	Stonehaven	770
Late Jul	1958	Stonehaven	770	" "	1955	Rattray Head	720
Early Jun	1966	Fyvie	880	Mid Nov	1969	Fyvie	880
No deficit	1948	Glenlivet	925	Late Oct	1959	Glenlivet	925
" "	1948, 1953, 1956	Dalwhinnie	1250	Early Oct	1955	Dalwhinnie	1250

Notes: (1) Stations listed in order of date of return.

(2) Full details of stations are given in Table 1.

(3) Rainfall average 1916-50.

Table 3. Dates of Return to Field Capacity 1954-73 - North of Scotland

Station	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Banff	Sep 27	Dec 4	Oct 22	Aug 23	Aug 3	Nov 16	Aug 20	Oct 18	Aug 21	Aug 14	Aug 30	Sep 14	Sep 24	Oct 22	Nov 18	Nov 29	Oct 27	Jan 14	Feb 21	Nov 9
Braemar	Sep 4	Dec 2	Aug 13	Aug 16	May 21	Oct 21	Aug 24	Sep 7	Sep 4	Aug 14	Sep 12	Sep 16	Oct 4	Sep 28	Oct 2	Nov 16	Jul 17	Nov 12	Dec 3	Nov 7
Craibstone	Aug 20	Oct 28	Aug 25	Jul 11	Jul 12	Nov 6	Aug 27	Sep 23	Aug 15	Aug 6	Sep 17	Sep 18	Oct 22	Oct 12	Oct 1	Dec 1	Aug 6	Jan 1	Jan 14	Nov 22
Fettercairn	Aug 3	Nov 7	Aug 8	Jul 18	X	Oct 25	Aug 16	Aug 22	Aug 12	Jun 12	Sep 25	X	Aug 13	Sep 22	Jul 24	Nov 5	Jul 26	Oct 26	Nov 17	Oct 14
Fochabers	Aug 24	Nov 1	Sep 28	Aug 20	Jul 19	Nov 10	Aug 16	Oct 25	Sep 29	Aug 16	Sep 17	Sep 13	Aug 3	Oct 22	Oct 29	Nov 21	Aug 25	Dec 16	Jan 15	Oct 18
Fortrose	Oct 10	Dec 12	Aug 13	Aug 22	Nov 2	Nov 26	Aug 23	Nov 18	Dec 8	Aug 24	Oct 20	Sep 19	Oct 21	Nov 20	Oct 15	Nov 24	Sep 19	Nov 24	Y	Nov 12
Inverness	Oct 16	Dec 16	Aug 14	Aug 21	Dec 9	Nov 27	Aug 18	Nov 14	Dec 7	Oct 12	Nov 1	Sep 16	Nov 1	Dec 4	Oct 14	Dec 6	Aug 28	Dec 3	Feb 17	Nov 23
Kinloss	Oct 16	Dec 20	Sep 15	Aug 9	Dec 5	Jan 2	Aug 24	Dec 2	Dec 3	Aug 28	Nov 10	Sep 23	Oct 4	Nov 16	Oct 19	Nov 24	Oct 14	Feb 11	Y	Nov 23
Kirkwall	Sep 5	Oct 10	Sep 13	Aug 9	Oct 23	Oct 18	Nov 3	Sep 21	Aug 12	Sep 2	Aug 13	Sep 2	Sep 2	Sep 1	Oct 10	Sep 17	Sep 25	Oct 17	Nov 9	Sep 5
Nairn	Oct 12	Dec 18	Aug 28	Aug 28	Nov 15	Jan 3	Aug 30	Dec 2	Dec 7	Aug 29	Nov 8	Sep 28	Oct 9	Nov 19	Oct 24	Feb 8	Oct 5	Dec 14	Y	Nov 29
Strathy	May 23	Oct 11	Jul 12	Jul 9	Oct 1	Aug 21	Aug 21	Sep 9	Aug 10	Aug 24	Aug 12	Aug 24	Jun 14	Sep 9	Oct 9	Sep 23	Sep 8	Oct 22	Nov 8	Aug 19
Wick	Sep 9	Nov 1	Oct 14	Aug 11	Nov 2	Nov 1	Oct 16	Oct 23	Sep 9	Aug 28	Aug 31	Sep 4	Aug 2	Oct 9	Oct 8	Oct 17	Oct 2	Nov 15	Nov 28	Sep 10
Area Mean	Sep 7	Nov 18	Sep 2	Aug 9	Sep 9	Nov 10	Sep 2	Oct 15	Sep 29	Aug 20	Sep 24	Aug 30	Sep 12	Oct 18	Oct 9	Nov 16	Sep 9	Dec 2	Jan 16	Oct 23

KEY:- X = No soil moisture deficit. Y = Did not return to field capacity.

Return dates in January, February and March refer to the following year.

F.R.

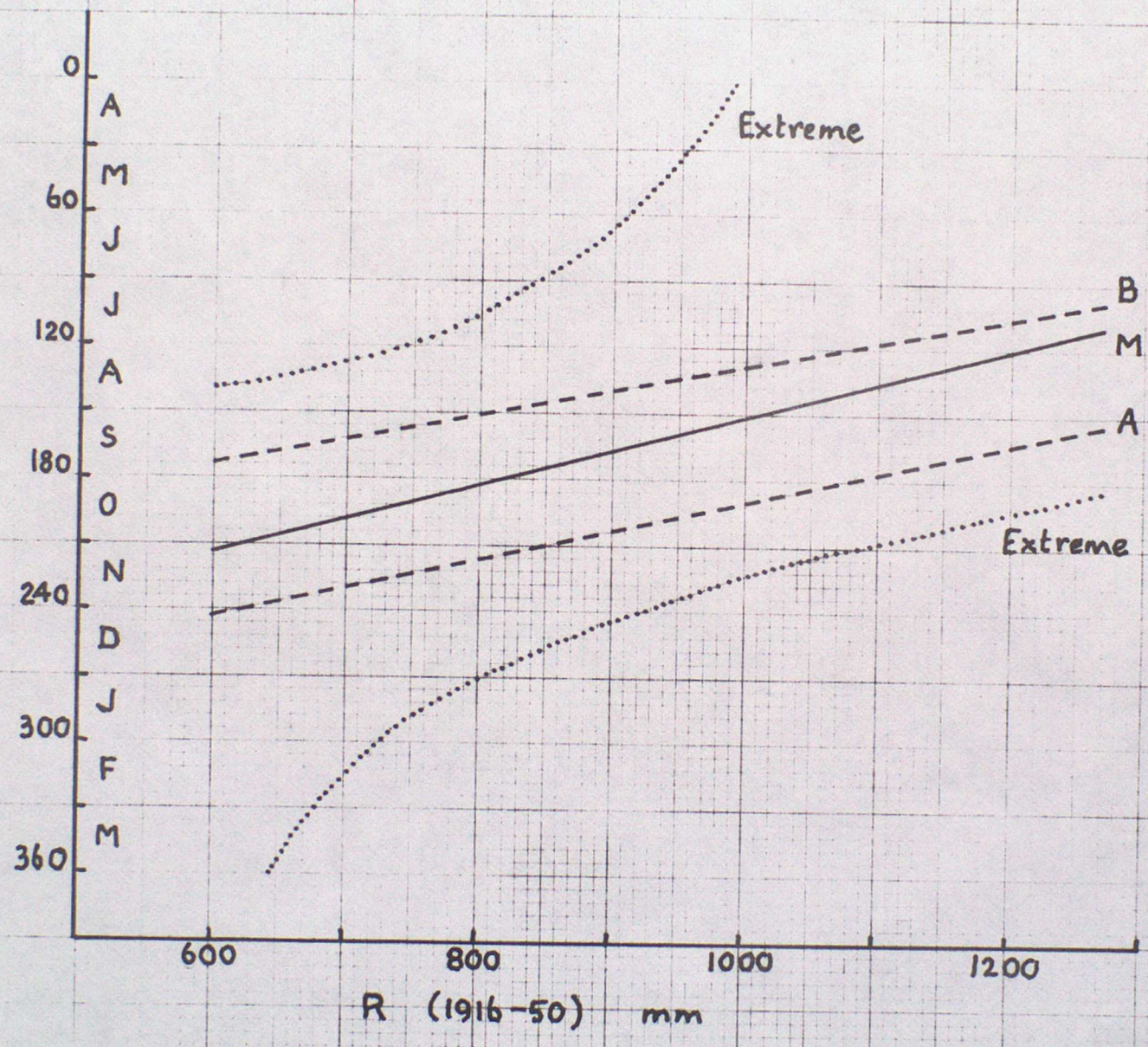

Fig. 1. Date of return to field capacity related to annual average rainfall